CHAPTER 8

STATISTICAL RELIABILITY CRITERIA

8-1. Objective. One principal advantage of analytical frequency analysis is that there are means for evaluating the reliability of the parameter estimates. This permits a more complete understanding of the frequency estimates and provides criteria for decision-making. For instance, a common statistical index of reliability is the standard error of estimate, which is defined as the root-mean-square error. In general, it is considered that the standard error is exceeded on the positive side one time out of six estimates, and equally frequently on the negative side, for a total of one time in three estimates. An error twice as large as the standard error of estimate is considered to be exceeded one time in 40 in either direction, for a total of one time in 20. These statements are based on an assumed normal distribution of the errors; thus, they are only approximate for other distributions of errors. Exact statements as to error probability must be based on examination of the frequency curve of errors or the distribution of the errors. Both the standard error of estimate and the confidence limits are discussed in this chapter.

8-2. Reliability of Frequency Statistics. The standard errors of estimate of the mean, standard deviation, and skew coefficient, which are the principal statistics used in frequency analysis, are given by the following equations:

$$S_{\bar{X}} = S/(N)^{1/2} \qquad (8\text{-}1)$$

$$S_S = S/(2N)^{1/2} \qquad (8\text{-}2)$$

$$S_G = \{6N(N-1)/[(N-2)(N+1)(N+3)]\}^{1/2} \qquad (8\text{-}3)$$

where:

$S_{\bar{X}}$ = the standard error of estimate for the mean

S_S = the standard error of estimate for the standard deviation

S_G = the standard error for estimate for the skew coefficient, and S and N are defined in Section 3-2.

These have been used to considerable advantage, as discussed in Chapter 9, in drawing maps of mean, standard deviation and skew coefficient for regional frequency studies.

8-3. Reliability of Frequency Curves. The reliability of analytical frequency determinations can best be illustrated by establishing confidence limits. The error of the estimated value at a given frequency based on a sample from a normal distribution is a function of the errors in estimating the mean and standard deviation. (Note that in practical application there are errors introduced by not knowing the true theoretical distribution of the data, often termed model error.) Criteria for construction of confidence limits are based on the non-central t distribution. Selected values are given in Table F-9. Using that appendix, the confidence limit curves shown on Figure 8-1 were calculated. While the expected frequency is that shown by the middle curve, there is one chance in 20 that the true value for any given frequency is greater than that indicated by the .05 curve and one chance in 20 that it is smaller than the value indicated by the .95 curve. There are, therefore, nine chances in 10 that the true value lies between the .05 and .95 curves. Appendix E and Example 1 in Appendix 12 of Bulletin 17B (40) provide additional information and example computations.

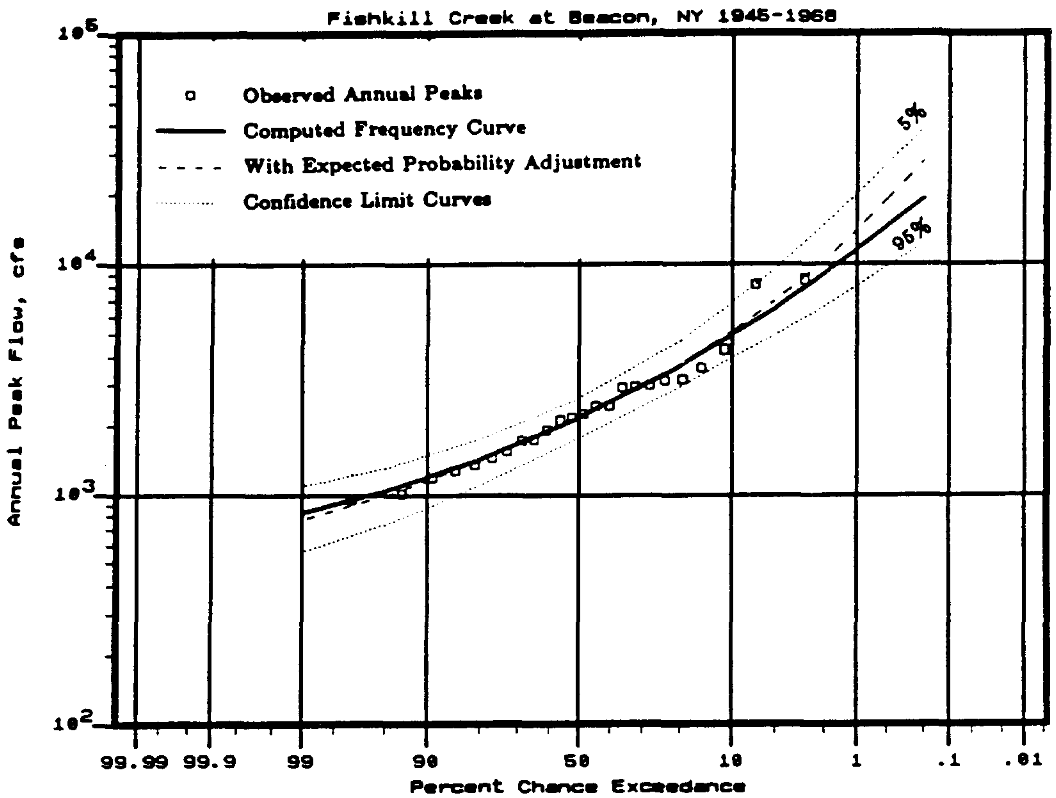

Figure 8-1. Frequency Curve with Confidence Limit Curves.